REMARKS/ARGUMENTS

1. Claims

Claims 1, 4-6, 9-13, 26-28 and 30 are pending in the application. Claims 5, 9, 10, 27 and 29 are withdrawn from consideration with applicants' reservation of rights to file a divisional application thereon. Claims 2, 3, 7-8, and 14-25 were previously cancelled.

Claim 11, 12 and 28 are withdrawn herein in view of the Examiner's objection raised on Page 2-3 of the Office Action. The withdrawal is made Applicants' with applicants' reservation of rights to file a divisional application thereon

Claims 1 and 26 have been amended.

Claim 1 has been amended to:

(a) correct "R_3" to read "**R**", therein R is an alkyl group, and

(b) to indicate that the glass layer deposited on the surface of a substrate is suitable for photonic devices.

Claim 26 has been amended to specify the R and R' alkyl groups.

New claim 30 has been added. [see also dated July 7, 2006. If this claim is not under consideration please contact the attorney.]

Therefore, after entry of the present amendments, the claims remaining in the application are claims 1, 4, 6, 13, 26 and 30

2. Drawings

The formal drawings previously submitted have been not yet been approved. However without specific rejection from the Examiner, Applicant will accept that they have been approved.

3. Detail Action

Applicants thank the Examiner for rejoining claims 26.

4. Claim Objections

The Examiner has rejected claim 11, 12, and 28 under 37 C.F.R. 1.759(c), of being improper form.

Regarding claims 11 and 12, the objection is moot in view of applicants withdrawal of the claims from consideration in further view of the Examiner's comment on page 3, line 1, of the Office Action.

5. § 112 Rejections

The Examiner has rejected claims 1, 4, and 26 under 35 U.S.C. §112, first paragraph, as being indefinite for failing to particularly point out or distinctly claim the invention.

A. Claim 1 and the term "R_3"

Regarding claim 1 and the term "**R_3**", the claim has been amended by correction the term "**R_3**" such that the claim now indicated that "**R**" is an alkyl moiety. This amendment is supported by Specification, fore example in Paragraph [0009], lines 1--5, and Paragraph [0021], lines 5-8. Applicants submit that in view of this amendment the rejection may now be withdrawn.

B. Claim 26 and the term "photolithographic techniques"

Regarding claim 26 and the term "photolithographic techniques," applicants traverse the rejection.

Paragraph [0029] indicates that a skilled artisan can combine methods of the invention with standard photolithographic techniques to form planar waveguides. The statement is indicative of the fact that one skilled in the art would know such photolithographic techniques and how to use them.

J. Hecht, Understanding Fiber Optics, 3rd Ed., (Prentice Hall, New York, 1999), pp. 297-299, describes planar waveguides and states "they are written using standard semiconductor techniques . . ." (page 298, lines 1-2 below the figure), such standard semiconductor techniques being photolithographic techniques as is well known to those skilled in the art. U.S. Patent No. 5,555,342 (Buchal et al) column 5, lines 18-37, describes making a planar waveguide including the use of "**convention lithographic techniques**". U.S. Patent No. 5,636,309 (Henry et al), column 2, lines 1-5, indicates planar waveguide Mach-sender type interferometers can be manufactured using "**standard photolithography techniques** and etching techniques."

Applicants respectfully submit that those skilled in the art would clearly understand applicants' term "photolithographic techniques" with regard to forming a planar waveguide, and that consequently the term is not indefinite.

The Examiner has "note" that since the claim requires "techniques," it does not encompass a process with only one photolithographic technique, and that many commercial process have hundred of steps, and that whether such process is one "technique " or many techniques is not ascertainable. Applicants submit that in view of the fact that those skilled in the art understand what is meant by "photolithographic techniques" or "standard photolithographic techniques" as stated in Paragraph [0029], the use of the word "techniques" is not indefinite. In addition, any such "techniques" would require the use of the claimed precursor compound in the making of the planar waveguide.

THEREFORE, applicants respectfully submit that in view of the foregoing facts and arguments it is proper for the Examiner to withdraw the §112, second paragraph, rejection of claim 26.

6. § 102 Rejections

The Examiner has rejected claims 1, 4, and 26 under 35 U.S.C. §102(b) as being anticipated by Adams, U.S. Patent Number 3,582,395. Applicants traverse the rejection.

Specifically, while the Adams patent teaches the use of alkylsilyl titanates *to prepare a scratch resistant surface*, Adams does not teach depositing a doped glass suitable for photonic devices on the surface of a substrate as claimed in applicants' claims 1 and 26. Adams teaches treating a surface with an alkyl silyl titanate using a "spray pyrolysis" method in which an alkysilyl titanate *in a solvent* is sprayed onto a heated surface as described in his claim 1 and the specification in column 2, lines 44-46 column 5, lines 14-17. The presence of the solvent and the reason for its presence is indicated in column 2, line 68, to column 3, line 9. The solvent is atomized during delivery, but does not evaporate until contacted with the heated surface. In applicants' invention the alkylsilyl titanate used as a "neat" material and not in the presence of a solvent. A solvent can lead to polymerization of an alkylsilyl titanate (zirconate) moiety and/ or effect the optical properties of the deposited glass such that it is not suitable for photonic applications. As indicated in applicants' specification, Paragraph [0002], lines 3-7, planar photonic devices require precise control of the refractive index of the deposited glass films.

In general, spray pyrolysis refers to atomizing a solution containing a precursor compound onto a heated susbtrate. Evaporation of solvent takes place both in the aerosol, and on the surface. Precursor compound is transported as an aerosol (i.e. liquid), and is thermally reacted to form the comound of interest by the hot substrate. Spray pyrolysis is employed because it is cheap. *However, the films it makes are not suitable for photonic devices. They are rough due to the impingement of aersol droplets, and they nearly always contain impurities from the solvent and incomplete pyrolysis of the precursor. The impurities create optical absorption and localized changes in refractive index, and the roughness causes scatter. All of these contribute to optical losses which make spray pyrolysis unacceptable for photonic devices.*

Therefore, in view of the foregoing facts and arguments, applicants respectfully submit that Adams does not anticipate the claimed invention and that it is proper for the Examiner to withdraw the §102(b) rejection of claims 1, 4 and 26.

7. § 103 Rejections

The Examiner has rejected claims 6 under 35 U.S.C. §103(a) as being unpatentable over Adams U.S. Patent Number 3,582,395 as applied to claim 1, and further in view of Antos U. S. Patent Number 5,296,012 and Blackwell U. S. Patent No. 5,154,744. Applicants traverse the rejection.

First, while Adams teaches the use of alkylsilyl titanates *to prepare a scratch resistant surface*, Adams does not teach depositing a doped glass suitable for photonic devices on the surface of a substrate as is claimed by applicants. Adams teaches the use of, for example, alkyl titanates in a solvent to deposit a titania including coating on a surface. Incorporating by reference the arguments presented above regarding the §102(b) rejection, the use of a solvent in the deposition of an alkylsilyl titanate or zirconate would not produce a glass layer suitable fro photonic devices including planar waveguides. Adams does not teach or suggest that the alkylsilyl describes therein are suitable to the preparation of photonic device or that they can be used in place of metal halides in any deposition process that can be used for the preparation of photonic devices. Adams does not teach or suggest that pure alkylsilyl titanates can be used in any process, but teaches that the alkylsilyl titanates are used with a suitable solvent to prevent polymerization or condensation reaction.

The use of a solvent is anathema in the formation of planar devices for reasons discussed above.

Antos teaches the use of a multiple burner system using metal chlorides in a CVD process and does not teach or suggest that compounds other than metal chloride are suitable for the PECVD process described therein. Antos teaches that one of the reasons for using a multiple burner system is to prevent incompatible components from contacting one another prior to oxidation because of the formation of particulates in the vapor transport lines (column 4, lines 2-5). Adams discusses the formation of polymerized or condensed species formed as a result of using the organometallic/solvent mixture described therein. Consequently, the problem Antos seeks to avoid could occur using the alkylsilyl titanates of Adams.

Finally, combining Blackwell with Adams and Antos does not teach the claimed invention. Blackwell teaches the use of pure titanium alkoxides to prepare titania-doped fused silica. Given that the materials must be transported through delivery lines to burners, the materials of Adams, which are solutions, could polymerize and plug up the transport lines. Adams does not teach the preparation and use of anhydrous materials. Consequently, combining Blackwell and Adams in the process of Antos would not result in the claimed invention.

Based upon the above amendments, remarks, and papers of records, applicant believes the pending claims of the above-captioned application are in allowable form and patentable over the prior art of record. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Applicant believes that no extension of time is necessary to make this Reply timely. Should applicant be in error, applicant respectfully requests that the Office grant such time extension pursuant to 37 C.F.R. § 1.136(a) as necessary to make this Reply timely, and hereby authorizes the Office to charge any necessary fee or surcharge with respect to said time extension to the deposit account of the undersigned firm of attorneys, Deposit Account 03-3325.

Appl. No.: 10/608,580
Amdt. Dated: September 12, 2006
Reply to Office Action of: April 4, 2006

Please direct any questions or comments to Walter M. Douglas at 607-974-2431.

15 September 2006
Date

CERTIFICATE OF TRANSMISSION UNDER 37 C.F.R. §1.8

I hereby certify that this paper and any papers referred to herein are being transmitted by facsimile to the U.S. Patent and Trademark Office at 571-273-8300 on: 15 September 2006

Date

Walter M. Douglas 15 Sept 2006
Date

Respectfully submitted,
CORNING INCORPORATED

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Enclosures:

1. J.Hecht, Understanding Fiber Optics, 3rd Ed.,(Prentice Hall, New York, 1999), pp. 297-299.
2. U.S. Patent No. 5,555,342
3. U.S. Patent No. 5,636,309

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go through it in either direction. If light enters the fiber end at upper left in Figure 15.6, the only way light can reach the fiber end at lower right is by reflection or scattering. Directivity is measured by comparing the input power, P_1, to the power reflected back through the other fiber end on the input side, P_4:

$$\text{Directivity (dB)} = -10 \log\left(\frac{P_4}{P_1}\right)$$

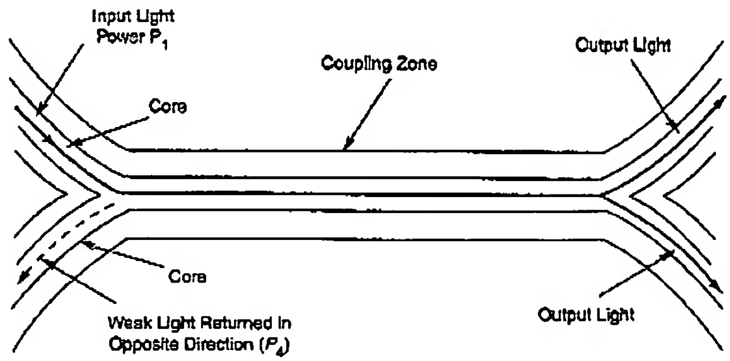


FIGURE 15.6
2 × 2 fused-fiber coupler.

For a typical fused-fiber coupler, the directivity is 40 to 45 dB.

The fused-fiber coupler design can be extended to multiple fibers using the same basic principles. The important change is adding more fibers, so signals from all the input fibers mix in the coupling zone and emerge out all the output fibers. This approach can be used to make star couplers with many distinct inputs and outputs, as shown in Figure 15.4. Multifiber fused couplers also are bidirectional.

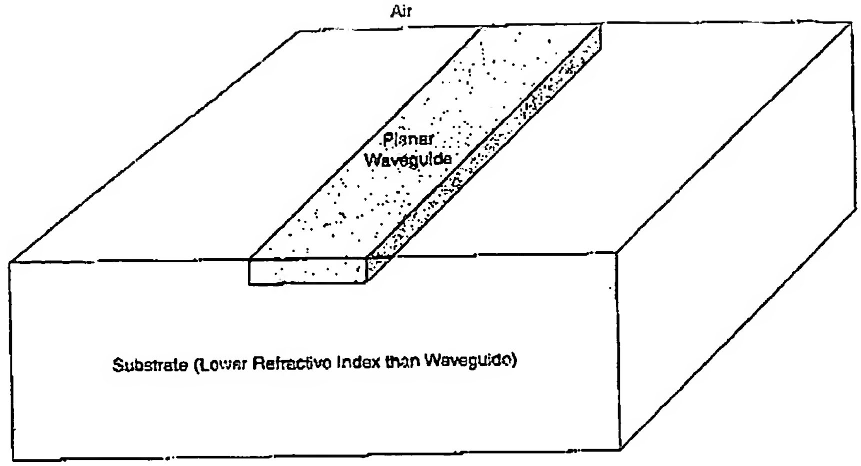
PLANAR WAVEGUIDES

Planar waveguides work like fibers, confining light to a zone with higher refractive index.

Optical fibers are not the only type of optical waveguides. Planar waveguides are based on the same idea of confining light in a region of high refractive index by surrounding it with material having a smaller refractive index. However, a planar waveguide is flat instead of cylindrical. Generally, a planar waveguide is a thin stripe of high-index material embedded in the surface of a flat substrate, as shown in Figure 15.7. It also can be a stripe deposited on top of the surface.

Typically, the stripe is made by diffusing a dopant into the substrate, which raises the refractive index of the material. The lower-index substrate material forms three walls of the waveguide, confining light in it. The top is exposed to air, which also has a lower refractive index, so the whole stripe serves as a waveguide for light. Planar waveguides are a versatile technology, also used in active devices described in Chapter 16, but here we will concentrate on planar waveguide couplers.

FIGURE 15.7
Cross section of a planar waveguide.



Simple waveguide couplers are branched planar waveguides.

Waveguides don't have to be straight lines. They are written using standard semiconductor techniques, so you can make them in a variety of patterns, including structures that branch and merge—the planar waveguide equivalents of fused fiber couplers.

The simplest type of waveguide coupler is a Y-shaped structure like the directional coupler in Figure 15.2(a). The actual split angle is much smaller than shown. If the output waveguides go off at equal angles, the light splits evenly between them. This approach can be extended to more than two outputs either by making more than two output branches or by putting two or more Y junctions in series, one after the other, to split the signal among multiple outputs. The division of power among the outputs depends on the junction angles and how successive junctions are arranged.

Light can leak between two closely spaced waveguides, forming a coupler.

Another approach is to use evanescent-wave coupling between two closely spaced waveguides, as shown in Figure 15.8. As with optical fibers, waveguides generate evanescent waves in the surrounding low-index material, and these evanescent waves can leak into adjacent waveguides.

In the evanescent wave coupler, the power in each waveguide varies along the length of the region where they are close enough for light to leak between them. As light travels along the upper waveguide in Figure 15.8, more and more of it transfers to the lower waveguide. This continues until all the light shifts to the lower waveguide at a point called the *transfer length*, which depends on the optical characteristics of the waveguide. Then the light starts shifting back from the lower waveguide to the upper one. Thus the distribution of light energy between the two waveguides oscillates back and forth between them with distance, as shown in the lower part of Figure 15.8. The oscillation stops at the end of the coupling region, determining the final distribution of light. Designers select lengths and optical properties of the two parallel guides to give the desired distribution of light (e.g., 50–50 or 75–25). In practice, some light is lost within the waveguide and in transferring between the two guides.

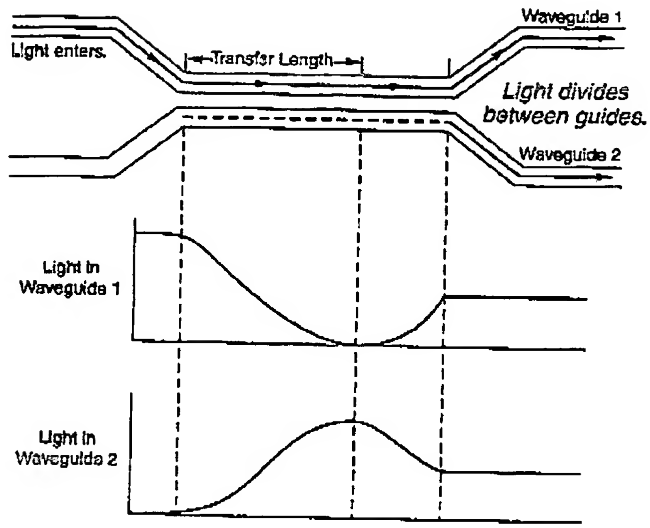


FIGURE 15.8
Light transfer between two evanescently coupled waveguides.

Surface waveguides can be fabricated in complex patterns on a variety of materials. When they are made on the same substrate with many other devices, they are often called integrated optics, but then they usually contain active devices such as lasers, switches, or modulators. Chapter 16 covers such devices.

Planar waveguides can be made in a variety of materials. They include glass, semiconductors such as gallium arsenide, and materials such as lithium niobate with properties that change when an electric field is applied to them.

One important practical issue with planar waveguides is transferring light between them and fibers. The thin, flat profile of a planar waveguide is a poor match for the cylindrical core of a single-mode fiber and presents some problems for the larger cores of multimode fibers. You need lenses and other optics to couple light efficiently from a fiber into a waveguide or from a waveguide into a fiber. In practice, this has been a major limitation on the use of planar waveguide components.

FIBER-GRATING COUPLERS

The Bragg fiber gratings described in Chapter 7 often serve as the basis of wavelength-selective couplers. Recall that the fiber grating selectively reflects light at a narrow range of wavelengths while transmitting other light. As shown in Figures 7.8 and 7.9, fiber gratings can be arranged in various ways to separate wavelengths for wavelength-division multiplexing. Because they are strongly selective, they are widely used for dense WDM systems.

Fiber gratings are used in wavelength-selective couplers.